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The Western Canada Semi-Arid Area – Its History and Probable Future



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Before the

WINNIPEG BANKERS' LECTURE CLUB

at the

FORT GARRY HOTEL
Wednesday, February 6, 1935

MR. A. J. WISHART,
of the Royal Bank of Canada, President of the Winnipeg
Bankers' Lecture Club, in the Chair.



Gentlemen:

This is the first time that I have presided over a lecture meeting of the Winnipeg Bankers' Lecture Club, and I wish to welcome so many of our members here tonight.

I also wish to welcome amongst us Dr. A. E. Savage, Dean of Agriculture of the University of Manitoba, and Professor Ellis, Professor of Soils, of the same University.

The speaker of this evening is in rather a unique position in that he is the first speaker who has been requested to address you for the third successive season. Your executive received so many requests to again have the speaker of tonight and that, in my opinion, may well be considered by him a very fine compliment indeed.

He is closely connected with agriculture in Western Canada. For a time he conducted a campaign for registered seed and in 1923 was awarded the senior honors for wheat in competition with the world at Chicago. He has won for himself a name as a student of economic and agricultural affairs and is at the present time in charge of the Research Department of the Searle Grain Co. His addresses of the past have been well co-ordinated and the material well delivered. The subject of his address this evening, "Western Canadian Semi-Arid Area," is one which has been before the public for some time now, and upon which a number of prominent persons have voiced their opinions. Our guest speaker is, I think, well equipped to voice his.

Gentlemen, I wish to introduce to you Major H. G. L. Strange.

The Western Canada Semi-Arid Area—Its History and Probable Future



BEFORE discussing the semi-arid area of Western Canada, its present situation, past history and its probable future, it might be well, perhaps, to refresh our minds with some of the principles which underlie the successful production and marketing of agricultural products.

First we must remember that most human beings subsist mainly on grass plants in one form or another, either upon the seeds of grass plants such as the seeds of the wheat, barley, oat, millet, rice and rye plants, which seeds, commercially called grains, are usually ground into flour and thence made into bread; or upon livestock products, such as beef, mutton, pork, milk, cream, cheese, eggs and poultry, which in turn are really a concentrated form of grass plants, leaves, stems and seeds, which have been consumed by animals, whose marvellous interior chemistry transforms them into the livestock products mentioned. In some cases certain of these livestock products, notably beef and mutton, are manufactured by the animals from the stems and leaves of the grass plants alone, without the grains or seeds being necessarily consumed at all.

So it will be seen that there are three distinct methods by which grass plants and their seeds can be transformed into foodstuffs for human beings.

Practically every piece of land in the world can produce grass to a greater or lesser extent; hence can produce food for human beings. The degree to which the production of foodstuffs is practiced in any given area, and the agricultural method practiced by which the grass is turned into foodstuffs; i.e., whether from the production of grains for making into flour or bread, or whether from the feeding of these grains and the leaves and stems together to livestock, or whether the feeding to certain forms of livestock of the stems and leaves alone, will depend upon certain factors. These are mainly the kind of soil, the amount of precipitation, the nearness to a necessary water supply for

the stock, transportation facilities to markets, and, as well, as to whether, all circumstances considered, the agriculture best suited for the area can successfully compete with similar products grown in other areas or countries.

If a form of agriculture, or the changing of grass into foodstuffs for human beings, can economically and successfully be practiced, in any given area, and if the products can be successfully marketed in competition with others, then it will usually be found that that particular form of agriculture is actually being practiced in such a given area. If, on the other hand, any persons were to attempt to enter into the business of the production of foodstuffs on a given area by means of an agricultural method that was not well suited to the area, unquestionably sooner or later those persons and their particular method would find great difficulty in surviving.

Applying the above principles to the Western Canadian semi-arid area, it would seem that in examining the situation one must continually bear in mind the thought: "Is the agriculture practiced in each area and district that which is best suited to that district and area?" At the outset I am personally bold enough to venture the opinion that substantially every single acre of land in the semi-arid area of the West is capable of growing at least some quantity of grass plants, and of turning such grass plants in a profitable and economic manner into some form of foodstuffs for human beings—foodstuffs, too, I believe, that can be successfully marketed, and so be the means of helping to support a farming family and thus of adding to the wealth of this country.

In most districts wheat production has been profitable in the past, and I for one feel that it will continue to be the most profitable form of agriculture in these districts for many years to come. In some parts of the area, however, soil and climatic conditions seem to have caused, even in the good years, average yields of less than ten bushels to the acre. It is highly probable that wheat growing, under these conditions, is not profitable and therefore should not be continued. Such areas, however, as already

has been suggested, can profitably produce crops with a different system of agriculture which can, I believe, easily be set up.

The Present Situation in the Semi-Arid Areas

For the purpose of this address, I should like to confine the discussion to that area in Saskatchewan stretching from the Manitoba to the Alberta border, and which lies south of the C.P.R., and which is generally termed the semi-arid plains of Saskatchewan, comprising Crop Districts 1, 2, 3 and 4, an area of about 40,000 square miles and where ordinarily an annual average of slightly over seven million acres is seeded to wheat. (A certain area, stretching into Southern Manitoba, and perhaps a larger area reaching into Southern Alberta, is of much the same nature.)

What exactly is the present situation in the area under review?

We find that large numbers of the farmers, no doubt the bulk of them, are not gaining sufficient income from their agricultural efforts to pay the costs even of their expenses. Therefore, they have to receive a considerable amount of help from Dominion and Provincial Governments and from Municipalities.

The reason for this situation is that for the last few years, varying in different districts within the area under review from two to five years, either less than normal rainfall has occurred or long dry periods have occurred between the showers, so that the production of crops has been scanty. The situation, of course, varies in different districts for the simple reason that the soil conditions vary, and the amount of the rain that has fallen and the length of time between the showers has varied too, not only from year to year, but during the course of the year.

The drought has brought with it other very disagreeable consequences. A severe plague of grasshoppers, cutworms, wireworms, and other crop-destroying insects; and, as well, has appeared the most troublesome problem of soil blowing.

An examination of the country itself discloses lakes, sloughs and water courses dried up, many trees and shrubs

killed, large cracks in the land in many places, and in most districts crops and sometimes the very grass itself either parched or dried or wholly or partially eaten by grasshoppers. In some districts, too, some farmers have abandoned the land altogether.

The Causes of the Situation

The above, I believe, is a reasonably correct picture of the present situation in most districts comprising the semi-arid area of Saskatchewan. Many theories have been put forward to account for it all, and as well proposals have been made by which it is suggested the situation might be remedied.

Some of the theories as to the causes of the present situation are as follows:—

That man himself has brought about the present distressful condition by—

- (a) Cutting down forests and trees and shrubs and by
- (b) Draining lakes and sloughs and water courses.

(The above actions by man, it is claimed, having decreased rainfall, increased evaporation and decreased the amount of water available as sub-soil reserve.)

and as well by—

- (c) Persisting with wheat growing on a large scale so that too much of the surface of the land in the area has been broken up, put into a fine condition, and so causing the evil of soil blowing.

Let us now, then, examine what evidence there is that man, with his wheat-growing activities, has brought about the present situation, or to what extent man has been responsible. To look into this question we shall have to deal somewhat with the history of the Western Canadian semi-arid areas.

At least four important explorations were made across the southern part of Western Canada before the actual settlement by white people took place. At the time of these explorations, the semi-arid plains were named in most geographies as part of the "Great American Desert."

David Thompson, of the Hudson's Bay Co. explored

from Lake Superior to the Rocky Mountains between 1784 and 1807.

Next, Captain John Palliser, on behalf of the British Government, explored from Lake Superior to the Rockies, thence to the Pacific; he also explored a large portion of the Western region of America from 1857 to 1860. He made a detailed survey of the hitherto unknown Western Canadian Prairie region.

Henry Youle Hind, on behalf of the Canadian Government, in 1857 and 1858, explored the Red River, the Assiniboine and the Saskatchewan.

John Macoun, on behalf of the Canadian Government, with various parties between 1872 and 1879, explored between the Great Lakes and across the prairies. Also he joined an expedition to the Pacific in search of a route for the Canadian Pacific Railway.

The detailed reports of these explorers are available and form most interesting reading.

They all agree that the northwest part of the United States, and an area extending into the southern part of Western Canada, in the form of a great triangle, with the apex just south of Saskatoon, are a semi-arid plain, mostly without trees, brush or shrubs, and in great part without any long or coarse grass.

Hind and Palliser thought that the area was quite unfit, excepting in certain small districts, for profitable farming purposes. Macoun, on the other hand, thought that wheat might be grown.

The reports indicate, too, that the area always has been noted for recurring periods of drought, when scrub and brush withers, lakes, sloughs and water courses dry up, and grass burns and wilts—all, however, to blossom again whenever the wet years return.

Some of the statements made at the time by those early explorers are as follows:—

Thompson, about 1802, on page 186 of "Thompson's Narrative of His Explorations in Western America, 1784-1812,"—"The great plains may be said to be barren for great spaces, even of coarse grass. . . . Even the rivers that flow

through the plains do not seem to fertilize the ground adjacent to them."

Palliser, in 1858, page 8 of "Official Report (1859) to Secretary of State for the Colonies, Great Britain," said: "The central desert extends in the form of a triangle from a base on the 49th parallel (the international line) from longitude 100 (a point near Killarney, Manitoba) to longitude 114 (a point south of Pincher Creek, Alberta) and the apex to the 52nd degree of latitude (just south of Saskatoon). Outside of this area is the fertile plain."

Hind, 1860, page 338, Vol. I, "Narrative of the Canadian Red River Exploring Expedition of 1857 and of the Assiniboine and Saskatchewan Exploring Expedition of 1858,"—"No tree or shrub or even willow tree could be seen in any direction from our camp (near Moose Jaw Forks) . . . (page 306) The great prairie west of the Souris continues treeless and arid for a distance of sixty miles without tree or shrub, and this was the utmost westerly limit to which any of them (the Indians) had journeyed in their buffalo hunting expeditions."

Macoun, 1879, in "Autobiography of John Macoun, M.A., Canadian Explorer and Naturalist," published by the Ottawa Field Naturalist Club, 1922, said on page 184: "There were at least 400 miles from Moose Jaw where there were no trees and scarcely a shrub." On page 199: "In 1879 I found a parched surface, dried and withered grass." On page 173: "In 1880 there were numbers of dried creeks on each line of travel." On page 287: "In 1894 the country was drying up, the lakes were disappearing, and many of the settlers were leaving the land. At this time nearly all the lakes and streams on the prairie had ceased to flow. We found the country everywhere dried up and the grass crisp and brittle." On page 268: "In all my explorations so far, we found the country extremely dry."

Hind, in his "Narrative of the Canadian Red River Exploring Expedition," included a map, based on his own and Captain Palliser's explorations, and on it he marked an area in brown which he described as fertile soil. South

of that belt he considered the country to be arid and unfit for general farming.

The Searle Grain Company recently published a map showing the wheat yield per acre for 1934 of the different districts in Western Canada, leaving in white those areas that yielded less than four bushels to the acre and shading lightly those areas that yielded from five to nine. The writer has superimposed upon this map "Hind's line of demarcation," showing the southern boundary of the fertile area. It is found that the triangular area considered by Hind and Palliser to be arid almost exactly coincides with the area in the West, principally in Saskatchewan, which this year has produced but little crop. (See map at end of booklet.)

Apparently, then, drought in this area is nothing new. Definite records reveal that for at least 100 years past the country has exhibited the phenomena of a certain number of years of scanty rainfall followed in turn by a greater number of years of good rainfall, to be followed in turn by a period of drought and so on.

From the statements made by the explorers quoted, it will be noted that the present situation in the semi-arid area is no different from that which existed in past periods of drought when, as noted by explorers, sloughs, lakes and water courses dried also, the grass was dried, withered, crisp and brittle, and in times of drought, then as now, some farmers left the land.

Coming with the drought during the last three years have been plagues of grasshoppers. This as well is nothing new in this area. Hind again, on page 296, Vol. I, of "Narrative of the Canadian Red River Exploring Expedition of 1857, etc.," wrote as follows:—

"On the 2nd of July we observed the grasshoppers in full flight towards the north, the air as far as the eye could penetrate appeared to be filled with them. They commenced their flight about nine in the morning, and continued until half-past three or four o'clock, in the afternoon. About that hour they settled around us in countless multitudes, and immediately clung to the leaves of grass

and rested after their journey. On subsequent days, when crossing the great prairie from Red Deer's Head River to Fort Ellice, the hosts of grasshoppers were beyond all calculation; they appeared to be infinite in number. Early in the morning they fed upon the prairie grass, being always found most numerous in low, wet places where the grass was long. As soon as the sun had evaporated the dew, they took short flights, and as the hour of nine approached, cloud after cloud would rise from the prairie and pursue their flight in the direction of the wind, which was generally, S.S.W. The number in the air seemed to be greatest about noon, and at times they appeared in such infinite swarms as to lessen perceptibly the light of the sun. The whole horizon wore an unearthly ashen hue from the light reflected by their transparent wings. The air was filled as with flakes of snow, and time after time clouds of these insects forming a dense body casting a glimmering silvery light, flew swiftly towards the North, North-east, at altitudes varying from 500 to 1,000 feet and upwards."

It is most interesting to note that the area infested by grasshoppers in the West this year coincided astonishingly closely with the area enclosed by the "Palliser" line.

The Royal Commission of Inquiry into Farming Conditions, Saskatchewan, 1921, and the Survey Board set up by the Alberta Government in 1922, to consider conditions in the then drought areas, found the situation then practically the same as we find it at present. They recommended measures, such as are being recommended today and will be described later, that should assist farmers to adjust themselves to drought conditions as they reoccurred from time to time. These Committees had no illusion that there was any magic cure for drought troubles. They considered drought periods would have to be lived with.

Man, therefore, cannot have been responsible, as charged by some, for:—

- (a) The recent drought, because severe periods of drought occurred before the settlement of the area by white people, nor for

- (b) The deforestation of the area and the cutting down of trees, for trees have never to any great extent, as far as available records reveal, existed in the zone in question. Indeed, the writer is inclined to the view that there probably are today more trees in this semi-arid area than there were before wheat growing was started, due to the many groves that have been planted by wheat growers around their farm homes. Neither has man been responsible for
- (c) The drying up of water courses and lakes, because, as noted by the old explorers, the drying up of lakes and water courses occurred in the past in periods of drought, again before a single acre of land was ploughed and put into wheat.

That, however, which it must be admitted man has been the cause of, has unquestionably been that in normal years of moisture there is now found to be less water in sloughs, lakes and water courses than there used to be, and that in present periods of drought lakes and sloughs dry up a little sooner than used to be the case, and no doubt stay dry a little longer after the dry years are over; this for the simple reason that before wheat growing was started a certain percentage, perhaps a very considerable percentage, of the rain that fell eventually found its way, running over the matted grasslands, into sloughs, lakes and water courses, whereas today a much less percentage of the rainfall is available for this purpose for the reason that man has ploughed up the top four or five inches of the soil and has made it like a sponge, so that today the greater part of the rain that falls is absorbed by the soil and so is not available to run off and to fill lakes, sloughs and water courses.

In course of time the rain so absorbed in the soil is transformed by nature's chemistry into wheat—wheat then is exported to the four corners of the earth, or briefly, one can say that a good deal of the rain which, before wheat growing was started, used to fill up lakes, sloughs and water sources, is now exported by the farmers out of

Canada. This, however, is part of the price that man pays for engaging in the industry of wheat production.

Man also has certainly been the cause, through his wheat-growing operations, of the affliction of soil blowing. This must be admitted. For the reason that in our semi-arid area insufficient rain, on the whole, falls in any one year to produce a profitable crop of wheat, it has been found necessary to practice summerfallowing, which is a method of utilizing two years of rainfall to produce, one hopes, one reasonably large yield of wheat. The penalty for this practice is that the top surface of the land has to remain bare, more or less free from weeds, for long periods during the year. During times of sub-normal moisture, the soil is in a fine condition and so easily blows when strong winds occur.

It is noted, however, that even with this bare, fine soil, whenever rainfall occurs that is normal or average for the district, very little or no soil blows at all. It is only in years of less than average rainfall that soil blowing becomes a serious problem.

Remedies Suggested

Those who consider that man has been responsible for bringing about the present situation in the semi-arid area, have made certain proposals, which in the main suggest that the erroneous steps which they consider man has taken should be reversed. In detail some of these suggestions are as follows:—

- (a) That forests and large belts and groves of trees should be planted throughout the country in order to increase rainfall and to conserve moisture.
- (b) That whenever possible creeks and water courses and other depressions should be dammed up so as to save the water from the melting snow and from heavy rains, so that this moisture will be available to fill up the sloughs, lakes and water courses, with the object in view of increasing sub-soil moisture to be available to crops.
- (c) That belts of trees and hedges should be planted on

a large scale throughout the country in order to lessen the force of the wind so as to prevent soil blowing.

Examining the above suggestions in order, it appears that the weight of meteorological, and indeed of some expert forestry opinion, is against the view held by some that trees have an effect upon rainfall. Meteorologists even go so far as to state that should, for the sake of argument, trees increase the amount of moisture in clouds overhead, that these clouds would be blown probably hundreds of miles away from the semi-arid area before the moisture would be deposited. In view of the above expert opinions, it would hardly seem as though any Government would be warranted in spending the tax-payer's funds for this proposal, or at least not until much more definite evidence of a nature favorable to the project becomes available.

With respect to the suggested conservation of moisture by trees in order to increase the production of crops, again the weight of expert opinion does not seem to justify this view.

Trees, it is stated, do conserve moisture, but only for their own use. Actually they will absorb all the moisture their roots can possibly obtain. In the semi-arid area it is even found necessary, if trees are to grow and thrive at all, not only to make available to them all the moisture that falls upon the land they occupy, but as well to make available to them additional moisture from adjoining land by keeping fallow a belt of land on each side of the trees. Far, then, from trees conserving moisture for the use of crops, actually it would appear that trees deprive adjoining crops of moisture which otherwise the crops could make use of.

With respect to the damming up of water courses, in order to direct the run-offs of moisture into channels so as to fill up sloughs, lakes and water courses, it hardly seems either that this would be of any benefit in increasing crop production. Certainly, immediately under such bodies of water as might be artificially made, the soil would be thoroughly well saturated, but there does not seem to be any evidence to show that this water would spread very

far in a horizontal direction in the first five feet in depth of soil. If it does not do this, therefore, it would be quite unavailable to adjacent growing crops.

Regarding the suggestion of planting trees and hedges in belts, to prevent soil blowing, it must be admitted that this is a very controversial matter. Expert opinions sharply differ as to whether any worthwhile beneficial effects would result at all, even though the belts of trees and hedges could be established. Some experts even go so far as to say that additional efforts would have to be put forth to protect the trees themselves from the damage of the blowing soil. Certainly even the most ardent supporters of this plan agree that belts of trees and hedges would have to be very close together indeed to have very much effect in dampening down the force of the wind.

Obviously, if the present large fields of wheat are to be cut up with groves of trees and hedges, production costs will be materially increased. As well is to be considered the undoubted growth of harmful weeds that would appear in between the trees and hedges and close to them, which farm implements would be unable to remove. Either, then, a large amount of hand-hoeing of such weeds would have to take place, around and in between these belts of trees, or the weeds would set to seed each year and so would rapidly infest the farmer's cultivated fields.

Then also there would be required a tremendous amount of work and energy in order to care for and cultivate such belts of trees and hedges. Experience has shown that even the comparatively very small groups of trees around farm buildings often perish from lack of proper attention and care. What then, it might be asked, would happen with hundreds or thousands of miles of such belts and groves?

Apparently, proposals such as the above, that have the end in view of increasing rainfall, increasing subsoil moisture, and so of alleviating periods of drought, and the additional troubles drought brings of grasshoppers, soil-blowing and poor crops, hardly seem to be feasible or practicable.

Proposals have also been made, too, for the bringing of

water from rivers in the north for the purpose of irrigating a good deal of wheat-growing land in the semi-arid area. This proposal hardly sounds feasible when one considers the difficulties farmers are having in other irrigation areas, particularly in Alberta. In any case, irrigation would not be suitable for wheat production for the reason that wheat produced under irrigation would not be of the high protein for which Canada is noted. It is probable that it would be difficult to find a sale overseas for such wheat at a profitable price, considering its comparatively low quality and high cost of production under irrigation.

Suggestions For Adaptation

Another set of suggestions has been made, however, not with the idea of attempting to change climatic conditions, or moisture reserves in the soil, or of stopping the force of the wind, but rather with the idea of assisting farmers to adapt themselves to the conditions that it is felt will inevitably occur as future drought periods again come around, and history seems to reveal they surely will come again from time to time in the future.

These suggestions are much more modest than the large-scale proposals that we have previously examined and they appear to have a good deal of merit. Some of them are as follows:—

(1) The developing of methods for the better conservation of moisture that actually does fall and is now trapped in the soil. At present not more than one-half of the precipitation that is actually deposited in the soil is available to the wheat plant. A large percentage is lost by evaporation; a small percentage by spring run-off (very much less than is usually supposed); a very small percentage from run-offs from heavy rains; and perhaps the largest amount of all because of the growth of weeds and other undesirable plants mixed in with the crops. Weeds use up an unbelievable amount of moisture.

(2) The better conservation of moisture with the end in view of lessening evaporation by different methods of cultivation. This problem has been studied for many years

past by scientific institutions, the Dominion Experimental Farms particularly at their stations at Lethbridge, Swift Current and Indian Head. Work along this line is steadily proceeding and progress is being made.

(3) The better conservation of moisture by lessening the present tremendous loss from weeds.

There would seem here to be a splendid field for attaining worthwhile results. Work here as well has been proceeding steadily for years with all our scientific Agricultural Institutions, and splendid results as we all know have been achieved. A somewhat novel field of endeavor has been opened up in this respect recently by the work being done, under the guidance of the National Research Council at the University of Saskatoon and at the University of Manitoba, in the excavation of different kinds of plants, with the complete rooting systems extending down to five feet or more, and by means of the examination and study of the competition going on underground between the rooting systems of useful plants and weeds. The writer is inclined to feel that results of importance to our drought areas will come out of this piece of research work. It should be pressed vigorously forward for it undoubtedly has great possibilities. (See appendix "A," Wheat Plant with Rooting System," at end of booklet.)

If a wheat variety could be developed that would require less moisture to manufacture a bushel of wheat, then that would be a most important method of moisture conservation. Such efforts are actually now being made by plant breeders.

(4) The study of just how the soil conserves and gives up moisture, and of just how the roots of the wheat plant and of other plants utilize that moisture is, too, most valuable. Such studies have been going on steadily, particularly at Swift Current Dominion Experimental Farm, and the results that have been found seem to reveal that many ideas previously held in this connection were in error. As more is discovered along these lines, the more one will understand how moisture can better be conserved in the soil and made available to the plant.

The importance of such investigations will be realized when it is stated that the wheat plant now requires between thirty and sixty tons of water to manufacture one bushel of wheat, or requires between 1,000 and 2,000 pounds of water to make one pound of grain.

It is also found that the roots of the wheat plant descend normally at least five feet into the soil, and utilize for each crop every scrap of moisture that the soil will give up to this depth. That moisture below the bottom of the roots seems hardly at all to be available for the use of the plant. That large quantities of root fibres are deposited each year in five feet of soil by the rooting system of the wheat plants.

(5) The study of soil management and farm management, and the rotation of crops and fields in order to lessen the evil of soil drifting, which occurs in the drought years. Again important studies have been conducted for a number of years at Lethbridge Experimental Farm and at Swift Current and Indian Head, and no doubt at other institutions as well, and important progress has been made. Such methods as keeping the top soil in a more lumpy condition, trying to keep some stubble and trash near the top of the soil, the use of a cover crop (that is to say, a light seeding of oats or barley in August, so as to hold the soil in place by the growth of plants and roots during the winter and early spring months), strip farming, both in an individual way and on a community basis, and other good practices are surely but slowly becoming known to farmers and no doubt in time will be common practices in areas suited to them.

(6) Some farmers in the drought area report that they have lessened the damage to their crops from soil blowing by the use of fertilizers. Ammonium Phosphate or Triple Super Phosphate fertilizer seem to develop a stronger and larger rooting system with the young plant and so enables it better to withstand damage, and perhaps more important still, enables the young plant to recover better after soil blowing damage has occurred. No doubt because of the better rooting system.

(7) Investigations into the chemical and physical properties of soils themselves are of major importance, for this permits the classification of soils in different areas and districts with a view to recommending the most suitable form of agriculture.

Soil surveys over large areas have already been finished so there is a field ready for action in the south country along these lines.

(8) Surveys of precipitation that falls at large numbers of different points. Similar surveys of evaporation and temperature variations. Much information along these lines is already available and the facts that can be compiled may be used to good advantage with the soil surveys that have been made. The importance of an accurate knowledge of precipitation that occurs is seen when it is realized that the moisture that falls between the harvesting of a crop and the next freeze-up has an important bearing upon the size of the succeeding crop. Not only is the total rainfall of importance to a crop but as well is the timeliness of its fall and the period that elapses between showers, for experience has shown that at certain critical periods, notably after about June 15th, that the wheat plant in the semi-arid area seems to be unable to withstand thirty days without rain without serious injury, regardless of how much precipitation occurs before or after the period of drought.

(9) A field survey for the purpose of determining the correct form of agriculture for which the particular district or even individual farm is best adapted. Taking into consideration such factors as soil, precipitation, location, availability of water, nearness to railways and markets. As already stated, it is at least this writer's opinion that there is **some** method of profitable agriculture that is adaptable to almost every acre in the semi-arid area. Where wheat cannot be profitably produced, no doubt the production of grass for livestock feeding purposes can be made profitable, particularly if the farms or ranches are made large enough.

No doubt a plan of this kind would involve the rearrang-

ing of some farms, and the re-locating of some farming families, although the numbers disturbed would probably be less than generally supposed. Needless to say, farmers moved should be generously recompensed in order that they may be re-established in a district where they would have a better chance, for in this connection we must remember that many farmers (not all, of course) who may be struggling in quite unsuitable areas and on unsuitable farms were partly induced to settle there because of the advertising of the country done by Governments, and our good Railroads. The expectations confidently hoped for by settlers have not all materialized. Naturally such advertising was all done in good faith by all parties at the time. It hardly seems quite fair, however, that the unfortunate farming family, struggling in this area, should be the sole sufferer.

Decisions would have to be made as to the exact disposition of such areas that would have to be put down to grass. Whether they should be leased to those who would engage in cattle or sheep raising or whether they should be made into community grazing areas. During each period of drought for at least thirty years past it has been suggested that community grazing areas be established on certain lands.

Trees and Hedges

Another splendid suggestion has been to encourage and assist farmers to grow at least a few trees and hedges around their farmsteads, this in order to provide shelter for human beings and livestock, vegetables and flower gardens, and berry plantations. Or to make life pleasanter and the farm more habitable.

On this modest scale there is no question but that trees can be grown provided they are of the right variety, planted sufficiently far apart, perhaps protected with hedges, and particularly if the farmer is willing to do the requisite amount of work each year required to maintain the trees in a flourishing condition.

A survey now being made by the Searle Grain Company, with the co-operation of the Municipal Secretaries, to at-

tempt to locate approximately every grove of trees that has survived the drought and as well to mark every grove of trees that has suffered, reveals that in some areas, curiously enough, trees seem to thrive quite well with but little attention. These areas, however, are few and far between. In other areas trees seem to die very readily, but over the great part of the semi-arid area, Municipal Secretaries, and those others who have had experience with trees, report that trees survive usually in accordance with the amount of work and care given to them. Observers state, however, invariably, that it does take a considerable amount of such care, which must be systematically given.

In almost every grove the recent drought has killed a percentage of the trees, and reports so far received (the investigation is still in progress) seem to indicate that some of the groves have been completely killed by the drought, although even in these cases Secretaries remark that some of the trees might have been saved had it been possible to have given them more care. The Dominion Government's Forest Nursery Station, at Indian Head, Saskatchewan, for a number of years has been distributing without charge trees suitable for planting in shelter belts around farmsteads. Complete instructions for planting and management are supplied.

This has been most excellent and valuable work and has resulted in hundreds, if not in thousands, of groves having been successfully established around farm homes, and so has made the lives of many farming families happier and more contented. This work should be vigorously pressed forward and if possible extended.

Next is another important and certainly sound suggestion, which is that farms in the semi-arid area should be encouraged, perhaps assisted, to become self-supporting so far as their own table is concerned, with eggs, poultry, milk, butter, cream, cheese, vegetables, berries, and flowers. This tends to make the farming family happier and more contented and, as well, tends to reduce the cost of production of wheat. Much along these lines can be done on al-

most any farm that is willing to plant hedges and simple wind breaks.

Next the suggestion to make dug-outs to collect the run-off from snow water and the run-off from very heavy rains, or the damming of streams for this same purpose wherever possible, this to provide water for the household or for livestock.

This, of course, has been done already on many farms, but unquestionably there are still some farms without any nearby available water, and so life is difficult and sometimes miserable for the farming family.

Extension Agents Lacking

With the exception of the re-allocation of farm land and families upon the right type of land, and the allocation of land to the type of agriculture to which it is most suited, practically all of the above suggestions, to some extent, have been advocated and to some extent put into practice for a number of years past. The writer is of the opinion, however, from his experience, in assisting farmers to make suggested improvements along agricultural lines, that extension work for the above-mentioned methods has been greatly handicapped from lack of a sufficient number of extension agents who are close to farmers and who are willing to assist. In a specialized effort with which the writer has been connected for the improvement of crops, termed "The Crop Testing Plan," it seemed that a new principle of inducing farmers to improve their agriculture has been discovered, it is exceedingly simple, and it brings gratifying results. It is that the assistance is invoked of those companies who handle the farmers' products—grain companies and others—who have hundreds, even thousands of elevator agents and their superintendents who have some spare time for several months in the year; who know the farmers and their conditions; and who, in addition, being under discipline from their companies, are well suited to assist in disseminating information among farmers, for better agricultural practices.

The definite suggestion is made, therefore, that in plans

for the assisting of farmers to adapt themselves better to the conditions of the semi-arid area, that grain companies, with their agents and employees, should be brought into the scheme, for they can render most valuable help, as has been proved, at no expense whatever to either governments or farmers, and with, in fact, but little expense to themselves.

A Drought Area Committee Needed

A good deal of valuable scientific information of a practical nature today is actually on file with many scientific agricultural institutions. Many experiments are under way; most valuable results have been obtained, and by many institutions efforts are being made to disseminate the information among farmers. This has been going on for many years, and is going on today, and, as stated previously, is bringing good results.

In the writer's opinion, there is no magic thing that can be done; no spectacular cure, no royal road to recovery from the drought, or anything that can possibly prevent drought coming in the future. There would appear, however, to be a profitable opportunity to spend a modest amount of money on adopting the proposal that has been recently made by several persons—Premier Bracken, of Manitoba, the Minister of Agriculture for Saskatchewan, the Hon. Mr. Taggart, and Dean Shaw among others—of setting up perhaps a Special Committee, whose duties it should be to collect as many facts as possible about the present situation in the drought area, to compile all the information that is available as to better agricultural practices that is known by various institutions, to make perhaps a decision as to what can **not** and what **can** be done, to lay plans for the assisting of farmers to put such ameliorative proposals into practice, and, as well, perhaps, to lay out further fields for study and investigation that might be conducted by scientific institutions along lines that have already been discussed.

Such proposals should finally be submitted by the special committee to the Federal Government with an estimate as to the cost that the work would involve. The Com-

mittee, as well, should be prepared, on favorable reception by the Government of the plans, to allocate different sections of the work and of the investigations among different branches of the Dominion and Provincial Governments, Universities and other organizations and institutions that are capable of fitting in to the plan.

Similar Committees in the past have performed valuable work; Committees, for instance, such as the Weed Advisory Committee, and the Meteorological Committee, which latter was set up some two years ago in Western Canada.

The definite suggestion is made by the writer that an already existing Committee, which is termed the Dominion Advisory Committee on Agricultural Services, whose membership includes representatives of the Dominion and Provincial Governments, might co-operate, as it already is doing with weed and other research work, with the National Research Council, and that together these might name a special Dominion Drought Area Advisory Committee.

The membership of such an Advisory Committee should include representatives of many branches of the science of agriculture, and as well representatives of sciences which directly and indirectly are allied to agriculture. It is suggested also that those middlemen who handle the farmers' products, such as Line Elevator Companies, should be induced to participate in the work, for the reason that these companies have many hundreds of employees covering practically all the districts of the drought area who would be invaluable for collecting and disseminating facts and information as required; these men being under discipline from head offices at Winnipeg could be dealt with by the Committee through such head office, and so their assistance could be obtained with but little expenditure of time by the members of the Committee.

Increase of Research Work

Should, for any particular reasons, the Government decide that an Advisory Committee of this sort is neither practical nor feasible, then there is one other plan which might be adopted, which unquestionably would bring good

results in assisting the farmers of the drought area better to adapt themselves in times of drought when such distressful periods occur. This would be simply to increase the grants of money to existing scientific agricultural institutions so that they could extend the scope of the work along the lines already mentioned, which they are now performing. Institutions such as the Dominion Experimental Farms, other branches of the Dominion and Provincial Governments, Universities and Agricultural Colleges. Increased grants would permit of more extensive investigations, research and demonstration work, which will assist in discovering and extending the use of agricultural practices better adapted to the arid area.

As an example of the splendid returns to the taxpayers that can be brought about by small expenditures of money to scientific workers, mention might be made of the results of a survey made by the Searle Grain Company, the aim of which was to try and determine approximately the value of the crops that were saved by the recent intensive and scientific grasshopper control campaign made during the past year. The results of the survey revealed that at the very least wheat alone to the value of eighteen million dollars was saved to the West, at a cost, it was found, of considerably less than one million dollars all told.

There is one other rather important contribution that could be made by the country to the drought area, which would be to assist the farming families themselves in a rather more generous manner, to allocate increased funds for better food, better clothing, better housing, and for better maintenance of implements and farm equipment, so that the farm would be efficiently and well able to cope with the increased crops which will come when climatic conditions are more favorable.

Value of Semi-Arid Area

In considering expenditures of this kind, the first thought which springs to mind is whether they would be well advised and whether the country could afford them: to examine the matter from this point of view it might be well

to set out the amount of wealth which the semi-arid area of Saskatchewan alone has contributed to Canada.

Taking the years between 1916 and 1930, a period of 15 years, which period suffered from 1916 to 1921, years of drought to a greater or lesser degree, it is found that the total amount of wheat exported out of this area, that is, Crop Districts 1, 2, 3, and 4 only, amounted to approximately one billion one hundred million bushels, which conservatively the writer has valued at one billion five hundred million dollars, this representing the wealth that this quantity of wheat brought into Canada, or an average of over one hundred million dollars a year that these four crop districts alone have contributed to Canadian wealth on an average for each of fifteen years.

Now the statement has been made by some that during the past four years of drought this semi-arid area has not produced any wealth.

I find that the same four crop districts for the past four crops have produced 174 million bushels of wheat alone, and have exported actually out of Saskatchewan no less than 128 million bushels of wheat, which I have valued most conservatively at 75 million dollars. Or a larger production (not value) of wheat, during the four drought years from these four crop districts alone, than the whole of Alberta has produced in any one year, and Alberta is rightly considered a large wheat-producing Province.

So it will be observed that even in the most distressful years of drought, even though farmers have to accept some assistance, that this area still makes a substantial contribution to the wealth of Canada.

Importance of High Quality Wheat

There is another and most important matter in this area to be considered, however, which is the extremely high quality of the wheat produced there. It is higher in protein than wheat from any other part of Canada, and undoubtedly high protein wheat from the south country has materially assisted Canada in retaining her very high reputation for quality on the world's wheat markets.

The importance of high quality in Canadian wheat cannot be overestimated. The writer is bold enough to hazard the opinion that if the quality of Canadian wheat were no higher than the average quality of Argentine wheat, that Canada would be unable to sell more than 100 million bushels per annum, or less than half the amount we now ordinarily export. If, further, the quality of our wheat were no higher than the average quality of European wheat, then it seems quite certain that sales from Canada would be almost negligible, for the reason that low quality wheat can be produced much cheaper in other parts of the world than in Canada.

Considering, then, the great wealth brought to Canada each year from this drought area, and the tremendous amount of employment in industry, distribution and transportation, caused by the flow of goods in exchange for the wheat exported, it will be seen that perhaps generous assistance afforded to the people of this district, and to the industry of agriculture in it, can be construed, not as an expense, but indeed as a very profitable investment to the people of Canada; at least we can say that were the people in these four crop districts to be forced to give up the production of wheat, it would be a major disaster to the whole country.

With it all, however, the writer feels that there is but little to worry about for the future, even though nothing whatever is done excepting to assist the people to maintain themselves. The rains, when they do come, will unquestionably reclaim the land for some agricultural purpose, and then excellent crops, of high quality, will again be produced. In the meantime somehow the people will survive with their morale and courage practically unimpaired, as Canadian people ever have done in the past.

Setting Aside Reserves

There is a basic problem to be faced with this area which has had to be faced with similar drought areas before, which is to encourage, induce and perhaps to assist the farmers to set aside in years of plenty adequate reserves, either of

money or of grains and feeding stuffs, so that they can maintain themselves during the lean years of drought when these come around once again, for come around again, in due course, they surely will, as history truly reveals.

This will probably be found to be the most difficult problem of all to solve. It has been a problem of a very grave nature, for the Governments of drought afflicted countries for thousands of years past. Records are available of elaborate plans that were practiced in drought areas in China, thousands of years ago. Joseph's example in Egypt, in the days of the Pharaohs, is typical of the kind of precaution that was taken in the past.

In any case, however, it is quite certain that the courage, ingenuity, inherent decency and honesty of Western Canadians will surely enable them to work out some plan to solve this important problem of adequate reserves.

Future of Area Sound

The years of drought and soil blowing have not, I believe, harmed the crop-producing ability of the land; and so I see no reason why that country should not once again, as in the past, support a population of prosperous farming families, producing large quantities of wheat and other foodstuffs which, I feel sure, the world even now really needs, and which products, in time, the people of the world will be willing and able to purchase at prices satisfactory to our farmers.

APPENDIX A

The print on this page is from a photograph of a wheat plant, including its root system, which plant was excavated and prepared by the Field Husbandry Department of the University of Saskatchewan from material grown in the wheat nursery, Saskatoon, as part of a co-operative weed research project carried on jointly by the National Research Council and the University of Saskatchewan. The wheat root was excavated, prepared and mounted by Mr. T. K. Pavlychenko.

It will be observed that some of the roots on the mount reach to a depth of 48 inches. Mr. Pavlychenko informs us that in the excavating of this plant 20 inches of the bottom of the mass of soil containing the root matter broke off, and that the root system would be showing as reaching to a greater depth had it been possible to have excavated the plant without damage. We are informed also that many of the finer roots are lost during the process of washing the soil away from the excavated root system.

On the material as it is shown, the total number of branches estimated is 2,804,538 of the first and second orders. In addition to these there was a large number of the third and fourth order branches. These being of extremely fine texture were mostly lost at the time of washing and for this reason are not included in the above estimation.

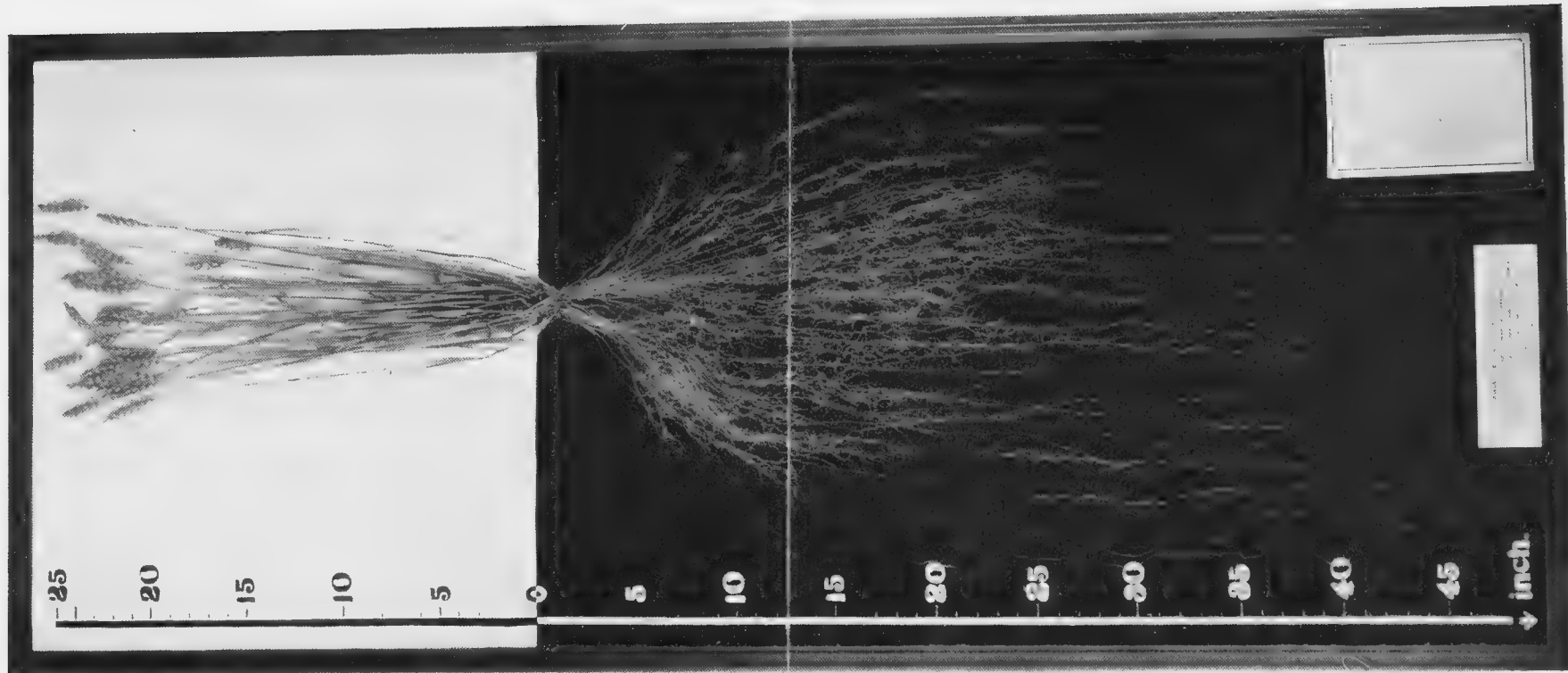
The root system includes both seminal and crown roots. The seminal roots are those which descend directly from the seed and the crown roots are those arising from the stem tissue between the seed and the ground surface.

The function of the root system of a plant is to obtain and convey soil nutrients to above ground portions of the plant for manufacture into leaves, stems, heads, spikelets and kernels. Investigations which have been made reveal that the roots of the wheat plant on our Western Prairies usually descends to about some 5 feet in depth, and that by harvest time, or maturity of the plant, the root system has absorbed every scrap of available moisture from the soil to about the depth the roots have penetrated.

Investigations conducted at the Dominion Experimental Farm at Swift Current reveal further that the only sources of moisture available to the plant are the precipitation which is conserved by summerfallowing or that which falls between harvest and freeze-up, plus, of course, the moisture that falls during the growing season. Contrary to general supposition it is found that moisture tends to descend into the soil and only rises through the force of capillary action with great difficulty and slowly—therefore moisture below the bottom of the roots is of very little use to the plant.

It is found that moisture which has once penetrated more than a few inches is locked in the soil until removed by the root system of some growing plants, hence the importance of attempting to practice that most efficient system of moisture conservation, i.e. the prevention of weed growth. The extensive root systems of weeds quickly exhaust the soil of moisture and the moisture and plant food which they take are, of course, not available for the wheat plant. The destroying of weeds, therefore, is one of the very best methods of conserving moisture and making it available to the wheat plants so that they can produce a good wheat crop.

APPENDIX "A"



A Wheat Plant with its Root System

Excavated and prepared by the Field
Husbandry Department, of the University of Saskatchewan.

Narrative compiled from information supplied by the Field Husbandry Department, University of Saskatchewan, and the Dominion Experimental Farm, Swift Current. Photograph and print arranged for by the Research Department, Searle Grain Company, Ltd., Winnipeg.

With the Compliments of the Searle Grain Company, Ltd.

YIELD PER ACRE OF WHEAT IN THE PRAIRIE PROVINCES 1934

ACCORDING TO INFORMATION SUPPLIED BY 900 CROP CORRESPONDENTS

CHARTED BY THE

SEARLE GRAIN CO., LIMITED

LEGEND ~

BUS. PER ACRE

25-35

LIMIT OF ARID PLAINS

AS CHARTED 20-24

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